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**Finch Beak Evolution Graphing and Statistics Activity – Part 2**

AP Biology, Ms. OK, 2014-2015

*Note: This activity is modified from an original activity created by HHMI Biointeractive. I do not claim any rights to the original activity.*

**Introduction**

In 1973, Princeton University evolutionary biologists Peter and Rosemary Grant began studying the

finches of the Galápagos archipelago, a group of islands about 600 miles off the coast of Ecuador. They

collected thousands of measurements every year to track changes in the physical characteristics of finch

populations over time. One of their major goals was to collect enough data to identify associations

between environmental and evolutionary changes in finch populations.

For their study, the Grants focused on the medium ground finch (*Geospiza fortis*), a seed-eating species

of finch on the island of Daphne Major. Every year the Grants measured physical characteristics like

wing length, body mass, tarsus length (the section of leg between the ankle and knee), and beak size for

hundreds of individual medium ground finches. Small changes in these structures can be important for

survival in different environments. In addition, these traits tend to vary widely within populations.

In early 1977 a drought began on Daphne Major. The drought lasted for 18 months and caused the type

and abundance of food available to the finches to change rapidly. Medium ground finches prefer to eat

the small, soft seeds of the bushy plant chamaesyce (*Chamaesyce amplexicaulis*), but the supply of

chamaesyce seeds was extremely limited as a result of the drought. As the drought progressed and the

hungry finches quickly ate the small, soft chamaesyce seeds, one of the only remaining food sources for

the medium ground finch became the seeds of a plant called caltrop (*Tribulus cistoides*). Caltrop seeds

are much larger and harder than those of the chamaesyce and are covered with pointy spines. More

than 80% of the 1,200 medium ground finches on the island did not survive the drought of 1977.

The Grants were interested in determining whether there were any differences between the finches

that survived the drought and the finches that did not—and in particular, whether any physical

characteristics were key to survival. To answer this question they compared the average value of

different characteristics in the finches that survived the drought to the average values of the same

characteristics in those that did not survive. They then applied statistical methods to determine whether

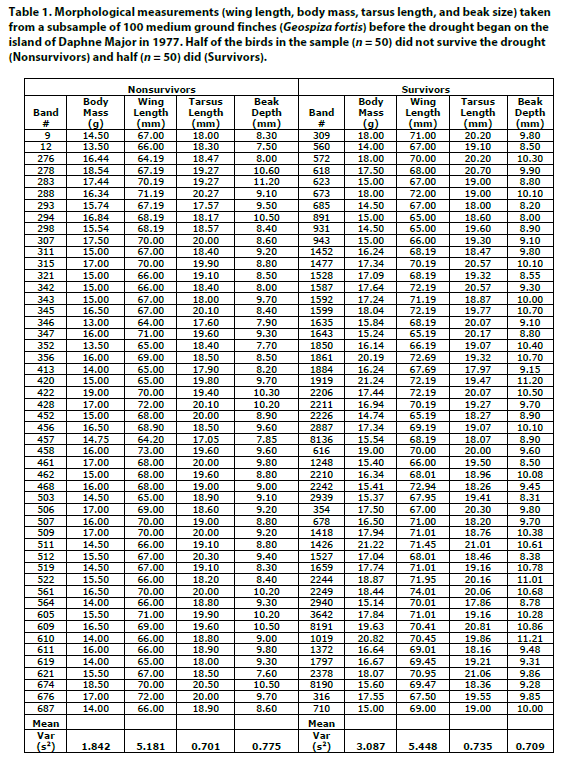
the differences they found between the two groups were likely to be real or merely occurred by chance.

You now have the opportunity to statistically analyze data collected by the Grants.

Table 1 (on the next page) shows body measurements from 100 medium ground finches living on

Daphne Major in 1976. Fifty of those birds did not survive the 1977 drought (nonsurvivors) and 50 did

(survivors).



**Procedure**

***Part A: Calculating Descriptive Statistics***

As you complete steps 1-3 below, enter your calculations for the, standard deviations, and 95%

confidence intervals in Table 2. The means have already been calculated for you.

**Table 2. Descriptive statistics for morphological measurements taken from 100 medium ground**

**finches (*Geospiza fortis*).** The data are presented in two groups: birds that did not survive the 1977 drought

(Nonsurvivors) and birds that survived the drought (Survivors).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Nonsurvivors** | | | | **Survivors** | | | |
| **Descriptive Statistics** | **Body Mass (g)** | **Wing Length (mm)** | **Tarsus Length (mm)** | **Beak Depth (mm)** | **Body Mass (g)** | **Wing Length (mm)** | **Tarsus Length (mm)** | **Beak Depth (mm)** |
| **Mean** | 15.71 | 67.79 | 19.04 | 9.11 | 16.99 | 69.30 | 19.35 | 9.67 |
| **Variance (s2)** | 1.842 | 5.181 | 0.701 | 0.775 | 3.087 | 5.448 | 0.735 | 0.709 |
| **Standard Deviation** |  |  |  |  |  |  |  |  |
| **95% Confidence Interval** |  |  |  |  |  |  |  |  |

1. **Calculate** the standard deviation (s) for each set of data. The standard deviation measures the mean

difference between each individual measurement and the mean of the entire population. Standard

deviation is a way to quantify how spread out a set of measurements is compared to the mean.

(Note: To calculate the standard deviation for a sample, simply calculate the square root of the variance

(s2) for that sample. In Table 1, the variance has already been calculated.)

2. **Calculate** the 95% confidence interval for each set of data.

Because you are analyzing random samples of 50 birds taken from the entire medium ground finch

population living on Daphne Major, it is not possible to know for certain that the means you have

calculated are the same as the mean of the entire medium ground finch population. This uncertainty is

because the mean of a sample of measurements is a single point estimate of the entire population

mean, which is also a single point. Thus, it is unlikely that your point estimate is the same as the true

mean of the population. By calculating the 95% confidence interval, you will be able to obtain an

“interval estimate” for the mean of the population. In other words, the 95% CI provides a range of values

within which the mean of the entire population is likely to be found.

As an approximation, use the simplified formula below to calculate the 95% confidence interval (95%

CI), where “n” is the sample size (50 birds):



**Part B: Graphing the Data**

3. On a separate sheet of graph paper or on your computer, **construct four bar graphs** that compare

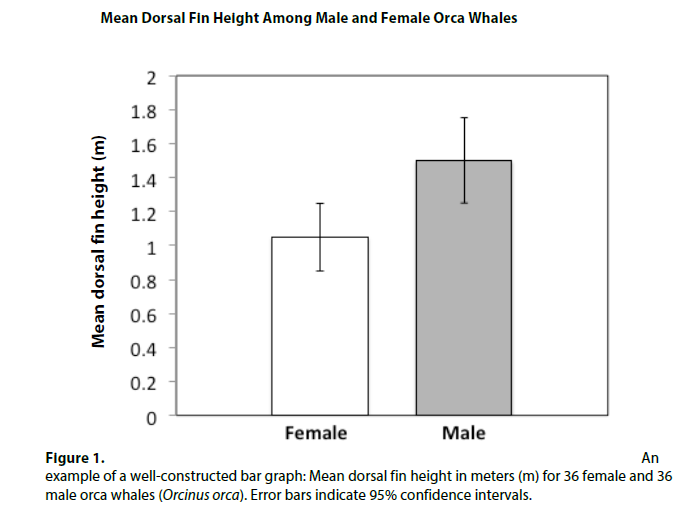
the means of nonsurvivors and survivors for each physical characteristic (wing length, body mass, tarsus

length, and beak size). Label both axes of each graph and show the 95% CI as error bars. An example of

a well-constructed bar graph is shown below (Figure 1).

Note: Scale your *y*-axes appropriately to highlight differences between the means; for example, the

smallest value on your *y*-axis does not always need to be zero.



4.Once you complete your four bar graphs, **describe** in the space below any differences between

nonsurvivors and survivors you observe in each graph.